Space Weather Technical Forecast

Issued on Monday, 15 July 2024 at 01:11 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-Class flares Likely (R1-R2 radio blackouts).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been High, with GOES16 recording a spate of M-class flares and a peak of an X1.2 at 14/0234UTC, with the majority of these emanating from AR3738. There are now up to eleven sunspots on the visible disc, with AR3736 no longer visible in the southwest. Main changes in the period included areal growth of the main penumbral spot in AR3738, although the overall area was roughly constant. This group is by far the largest and most complex and retains several candidates for Mt Wilson delta spots. Also of note was a proliferating trend of intermediate spots in AR3743 near centre-disc to become a Dai/Beta, while in the northeast AR3744 started to show signs of a north-south aligned delta spot in its main leading group.

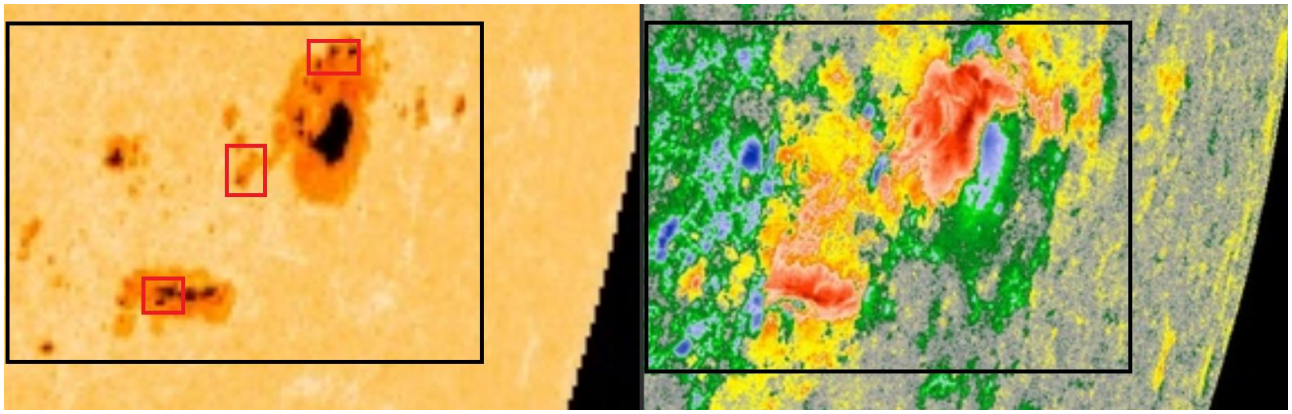

Figure 0: HMIIF and HMIBC 14/2230UTC, showing AR3738 boxed black and several candidates for Mt Wilson delta regions (boxed red). Also shown in the western solar horizon for scale – the group itself now spans around twenty degrees solar longitude.

Despite the number and scale of solar flares, no Earth-directed CMEs have been observed. Coronagraph imagery showed far-sided northeast and far-sided southeast-directed CMEs, as well as a possible third event from near the southern crown. None of these affect the forecast.

Solar Wind / Geomagnetic Activity: The solar wind signal comprised variations on a slow regime, as measured by ACE at L1. The solar wind speed was at background levels between 275 and 325km/s. The solar wind density was also within long-term background in single figures ppcc, while the IMF was at background with a peak of 7nT and a north-south variation of +3 and -4nT. The phi angle spent roughly equal periods in positive and negative territory.

The net result of the above solar wind measures was for provisionally Quiet Kp indices throughout.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background, despite numerous large flares from a potentially prone

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location (AR3738 nearing the western solar horizon).

High energy electron flux (greater than 2MeV) observed by GOES16 was at Normal Background. The 24-hour fluence was below Active, with 1.46e6 integrated pfu observed at 15/0001UTC.

Four-Day Space Weather Forecast Summary

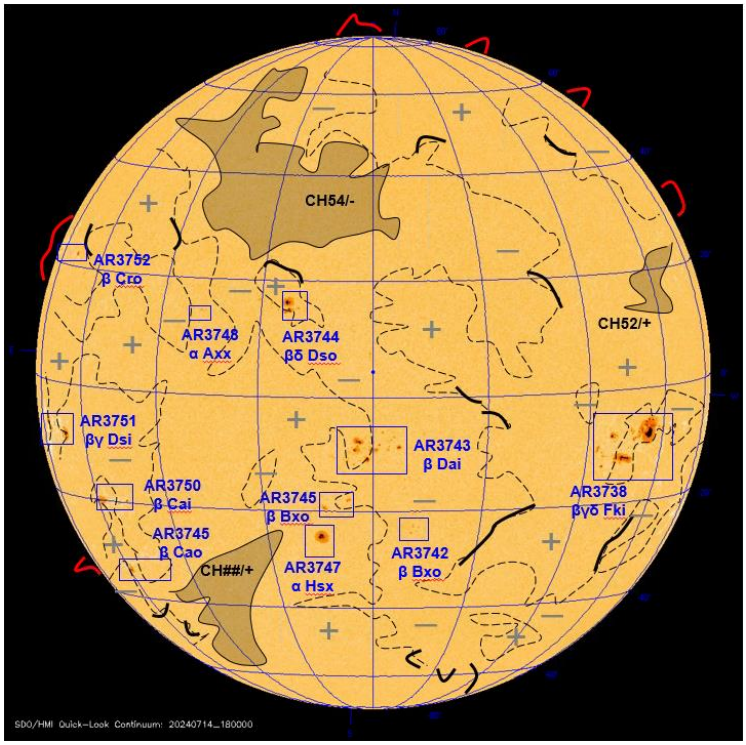
Solar Activity: Further M-class flares are Likely, with a Slight Chance of further X-class flares, most likely from AR3738. This risk abates slightly after midweek with the main sunspot group leaving the facing side of the Sun.

Solar Wind /Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. CH52 may now give Unsettled periods on days one and two (Monday 15 and Tuesday 16 July). After a return to Quiet conditions midweek there is then a Slight Chance of G1 from any CIR on the periphery of CH54/- to end the four days.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background levels, but with a Slight Chance of rising in response to any notable flares, mainly from AR3738.

High energy electron flux is expected to persist at Normal Background levels for much of the period, with any fast wind from CH52 expected to be muted, and a second fast wind not likely to feature until after midweek UTC - too late to have any impact on 24-hour fluence in this four-day forecast period.

Figure 1. Solar Analysis Valid 14/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast.

The forecast otherwise comprises up to two fast winds - firstly the overdue and consequently now muted fast wind from CH52/+, which may have now arrived at STEREO A (from MAG and PLASTIC evidence). This appears to be a subdued affair if this is the cause of STEREO's slight enhancement, with a slight density increase from a CIR leading into a 400km/s fast wind. Unsettled periods are considered possible in the first two days of the period - probably arriving in the current UTC afternoon period - before eventually waning to Quiet by midweek.

The second fast wind is something of an unknown quantity, as although it was present on last pass, it caused no notable effect on geomagnetic activity. MOSWOC Enlil's treatment of all coronal holes in the period is almost anti-phase compared to expectations and very likely over-stated in terms of magnitude.

On balance, a slight increase to the solar wind is possible into the new UTC week from CH52/- and then a stronger glance from any CIR on the southern extremity of CH54/- around Thursday 18 July, perhaps leading to a Slight Chance of G1 for the latter, but more probably a miss.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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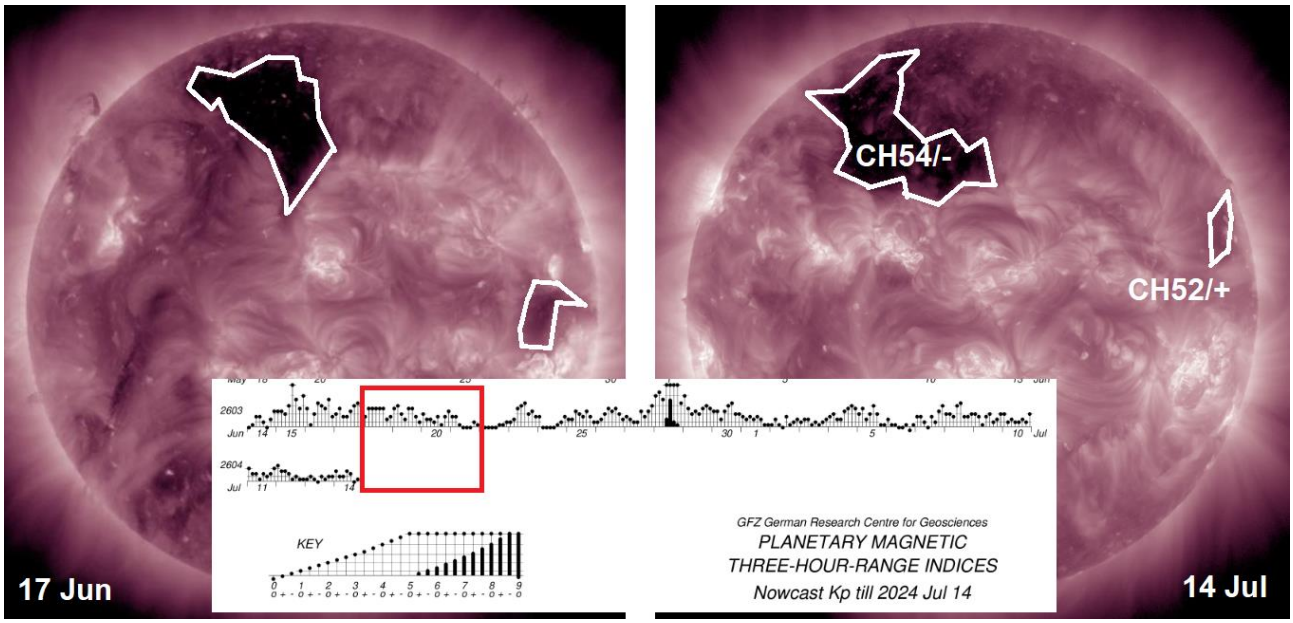
Figure 2: Past and present rotations in AIA211, showing little geomagnetic response through the red-boxed forecast period from either CH52's or CH54's predecessors. Shown inset is Bartels music plot, retrieved from https://kp.gfz-potsdam.de/en/figures/bartels-music 14/22:49UTC.



Radio Blackouts - X-Ray Flares:

Current activity is dominated by AR3738 in the southwestern solar quadrant, and is proving episodic - presumably tied to minor changes in the configuration of spots within the group, as the overall class has been little changed in recent days.

Concerning the balance of regions and trends in activity, far-side helioseismographs show a steady cadence of echoes that may hint at several arriving sunspot regions in the period, perhaps including that responsible for a far-sided partial halo CME seen around the middle of last UTC week. On the front side, the only notable sunspot that is expected to depart in the four days is also the largest and most active, with AR3738 due to progressively rotate off on Thursday 18 July.

The certainty of AR3738's passing versus the speculative nature of any arrivals over the eastern limb is the rationale for the slight downturn in risk on day four, however given the sunspot region's size, it may well be two full UTC days before the risk settles at a new lower level.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	75	60
Very Active	R3 to R5 X Class	Yes	15	15	15	10

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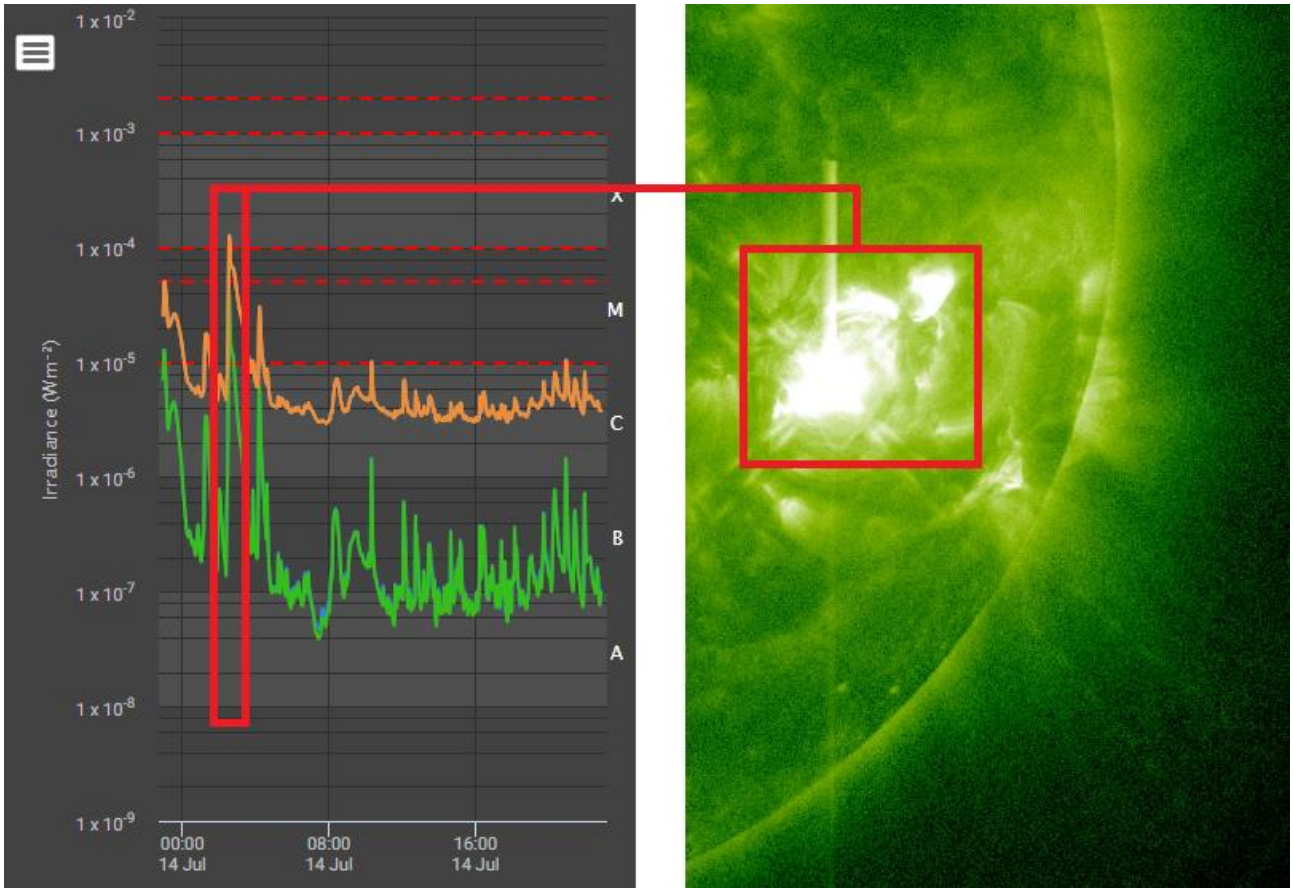
Figure 3: GOES16 X-ray trace and AIA094 imagery, showing the peak X1.2 flare from AR3738 at 14/0234UTC.



Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at Background, and has remained unmoved by recent large X-ray flare activity from AR3738 in particular. Despite this recent lack of any enhancement, there is considered a daily Slight Chance of exceeding the S1/Minor radiation storm threshold should any further significant flares occur, these perhaps most likely from AR3738. This risk should begin to fall later in the UTC week as the pre-eminent sunspot AR3738 begins to rotate onto the far side and its contribution decreases.

Radiation Storms Probability (Exceedance)	**Level (cm^{-2} sr^{-1} s^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC) (%)**	**Day 2 (00-24 UTC) (%)**	**Day 3 (00-24 UTC) (%)**	**Day 4 (00-24 UTC) (%)**
Active	**≥ S1**	No	10	15	15	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux is now considered less likely to show any notable response to any eventual fast wind from CH52/+, for this feature being overdue and therefore of lower magnitude. There are then likely no further drivers to change counts at GEO until after any possible onset of CH54/-, however with this potentially due on or around Thursday 18 July, any eventual uptick in fluence will most likely fall outside this 96-hour window.

For what it's worth, recent MOSWOC REFM runs are considered to be offering reasonable guidance in their continuing flat forecast trend, although in this case its utility is limited as there are no expected mechanisms to alter the current sub-Active conditions.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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